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Optical Measurements and Temperature Dependence of the Energy Gap in $ZnIn_2S_4$ Layered Compound

By

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Introduction The information on the temperature dependence of the fundamental energy gaps in II-III_2-VI_4 compounds is relatively scarce. Taking account that these compounds have interesting photoelectric and luminescent properties /1 to 3/, that makes them good materials for possible applications in semiconducting devices, a further investigation of the temperature dependence of the energy gaps is necessary. One of these materials is $ZnIn_2S_4$ which exists in many polytypic forms /4/. The results we present here are for the $ZnIn_2S_4$(III) form, as determined by Lappe et al. /5/.

The structural and electrical properties of $ZnIn_2S_4$(III) were examined in some previous works /6 to 11/. This compound crystallizes in the C_{3v}^5 (R3m) space group with lattice parameters a = 0.385 nm and c = 3.702 nm. It must be noticed here that to the same structure belongs the compound $CdInCaS_4$ /12/ for which the optical properties have been published recently /13/.

It would be of great interest to examine the optical behaviour of $ZnIn_2S_4$(III) in order to elucidate whether the similarities between the structures of these layered compounds do extend to their optical properties, too. It is also significant to determine how the studied structural and electrical properties of $ZnIn_2S_4$ affect its optical properties.

Previous works on $ZnIn_2S_4$(III) concerning some optical properties of this material exist in the literature /14 to 16/. In the present work, we report about the temperature dependence of the fundamental energy gap in $ZnIn_2S_4$(III) in the temperature range from 90 to 450 K determined by absorption measurements. From these measurements, we perform a precise evaluation of the relation between E_g and T as well as a rough estimation of the Debye temperature T_D for $ZnIn_2S_4$.

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